

Case reports

Diagnosis of pseudoaneurysm of the ascending aorta by pulsed Doppler cross sectional echocardiography

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SUMMARY Pseudoaneurysms of the ascending aorta are relatively uncommon compared with those evolving from the left ventricle. In a young man with endocarditis of the aortic valve who developed a pseudoaneurysm arising from the ascending aorta, the diagnosis was established with the pulsed Doppler technique and cross sectional echocardiography by passing the Doppler sample from the aorta through the neck of the false aneurysm into the large pseudoaneurysm. Aortic root angiography showed this connexion to be a small fistula between the aorta and right atrium. Necropsy findings confirmed the diagnosis.

Pseudoaneurysm of the ascending aorta is a rare entity. False aneurysms have a tendency to early and late rupture, necessitating early diagnosis and prompt surgical intervention. Until recently, only angiographic evidence of the small connexion between the false aneurysm and true aortic lumen could confirm the diagnosis. To our knowledge, there has been only one report that describes the use of pulsed Doppler cross sectional echocardiography in confirming the diagnosis of pseudoaneurysm. Grube *et al* were able to pass the Doppler sample through the communicating neck of a false aneurysm of the left ventricle while constantly monitoring flow.¹ We present here a most unusual case of a massive pseudoaneurysm of the ascending aorta diagnosed by combined echocardiography and the Doppler technique.

Case report

A 37 year old, previously healthy white man developed chronic osteomyelitis of the right leg after being struck by a car. He presented with *Staphylococcus aureus* endocarditis of the aortic valve. A Björk-Shiley aortic prosthesis and appropriate antibiotic treatment adequately relieved his symptoms. Several months later, he presented with recurrent signs of endocarditis and a loud murmur of aortic regurgita-

tion. *Staphylococcus epidermidis* endocarditis with dehiscence of the aortic prosthesis was diagnosed. At operation, the aortic annulus was necrotic with one abscess. An Edwards porcine prosthesis was inserted with Dacron reinforcement of the ascending aorta. In the immediate postoperative period, he developed sharp substernal chest pain radiating to the back which was associated with a harsh systolic ejection murmur at the second right intercostal space. The pain became progressively more severe and was associated with tenderness in the fourth right intercostal space. There was a well localised pulsation in this area associated with both a systolic murmur and a diastolic decrescendo murmur. An echocardiogram was performed followed by cardiac catheterisation.

Cross sectional echocardiography (Fig. 1) detected a large mass anteriorly which compressed the right heart and ascending aorta. The right ventricle and right atrium were clearly defined as narrow distorted cavities, and the tricuspid valve showed an extremely erratic motion pattern. Careful examination along the right sternal border detected a small communication between the large anterior mass and the adjacent ascending aorta (Fig. 1b).

Pulsed Doppler echocardiography (Fig. 1b) was performed on an ATL Mark V pulsed Doppler instrument with a zero crossing time interval histogram spectral display of velocity. Flow profiles within the mass and ascending aorta showed a similar direction, but flow within the mass was much more turbulent. Furthermore, the Doppler sample passed easily through the communication of these structures and

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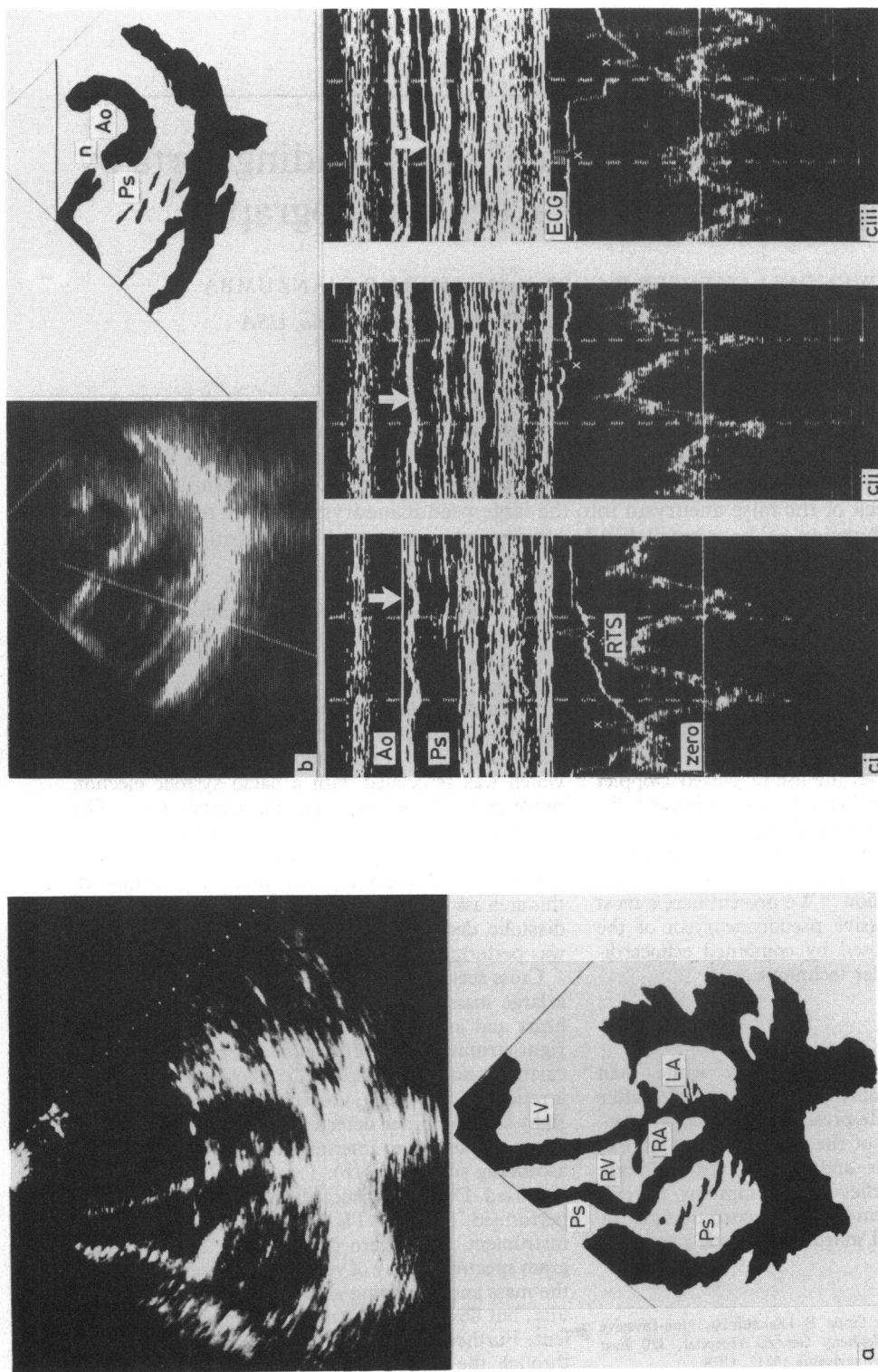


Fig. 1 Original cross sectional echocardiograms (a) in the apical four-chamber projection (with corresponding diagram) showing a massive pseudoaneurysm (Ps) compressing both the right atrium (RA) and right ventricle (RV) (LV, left ventricle; LA, left atrium) and (b) in the right parasternal view (with corresponding diagram) showing the ascending aorta (Ao), the neck of the false aneurysm (n), and the pseudoaneurysm (Ps). (c) Real time spectral analysis of the Doppler shift frequency (RTS) is shown below the M mode recording with flow toward the transducer shown above the zero velocity line (zero) and flow away from the transducer shown below the zero line; the path over which the continuous sample volume was obtained is indicated in (c) by the depth line (arrow). The flow profile is analysed with reference to the electrocardiogram (ECG), in which each QRS complex is indicated (X). In (ci) the sample volume is in the aorta and shows a similar spectral pattern as seen in (cii) with the sample volume positioned in the neck of the false aneurysm. Note that systolic flow is away from the transducer and toward the pseudoaneurysm, but in diastole flow is out of the aneurysm and toward the transducer. In (ciii) the sample volume is within the false aneurysm and shows a wide variance in the velocity waveform with a much larger negative component in systole. This indicates turbulence within the aneurysm as the red blood cells have a variable direction and velocity which produces a spectral display with a widely dispersed dot pattern.

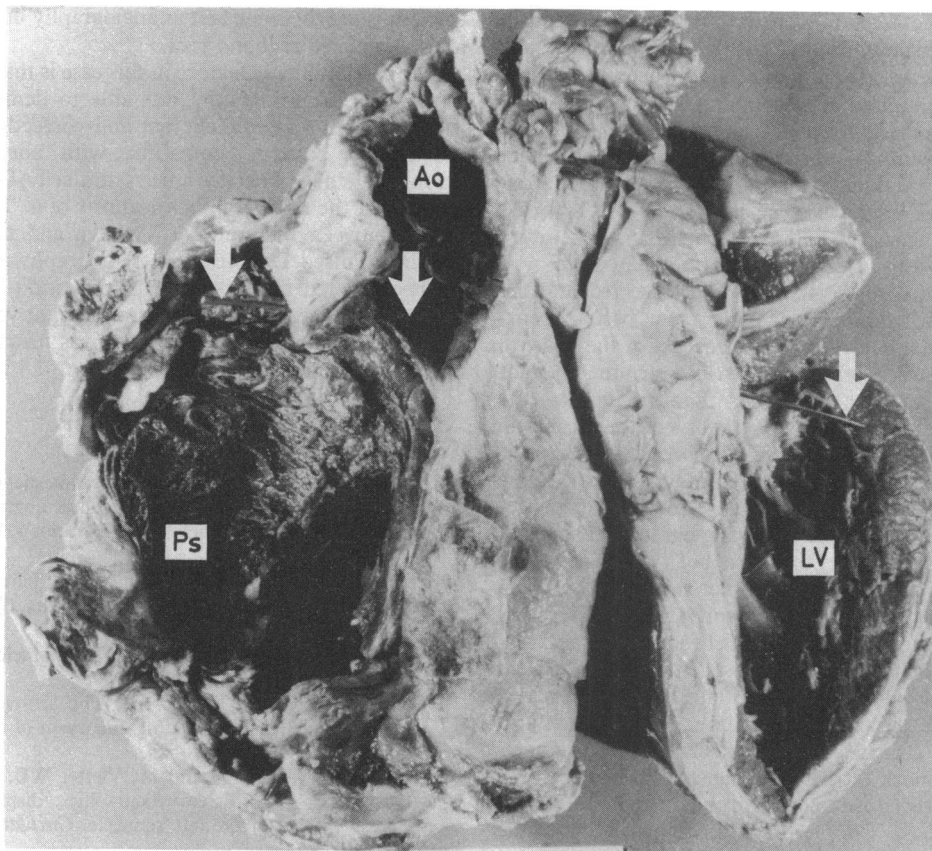


Fig. 2 Morphological appearance of a large pseudoaneurysm of the aorta (Ps). Note the presence of a probe (arrows) which passes from the left ventricle (LV) through the aortic valve into the ascending aorta (Ao) and through the neck of the false aneurysm into the large cavity of the pseudoaneurysm (Ps), which contains large amounts of clot and fibrinous material.

showed a flow pattern similar to that obtained within the aorta thus identifying it as the neck of the false aneurysm. The flow profiles in the right heart chambers were dissimilar in contour and direction and showed no communication with the mass.

Cardiac catheterisation showed a tricuspid valve compression deformity with a 5 mm diastolic filling gradient and a small volume fistula into the right atrium from the aorta or sinus of Valsalva. An additional compression deformity was noted affecting the ascending aorta. The angiographic study also indicated dehiscence of the aortic prosthesis with perivalvar leak. Based on these findings, the patient was offered a third operation. Nevertheless, he declined further therapeutic intervention and died several days later.

The postmortem examination confirmed the diagnosis suggested by the Doppler study. The heart was enlarged and weighed 1.25 kg. There was a marginal

tear of the aorta at the level of the prosthetic valve which communicated with a massive pseudoaneurysm compressing the entire right side of the heart (Fig. 2). The false aneurysm's greatest diameter was 15.0 cm. The wall of the pseudoaneurysm was composed of fibrin, blood clot, pericardium, and calcified connective tissue with focal areas of lymphocytic infiltrates.

Discussion

Pseudoaneurysms of the ascending aorta are relatively uncommon compared with those evolving from the left ventricle. This is undoubtedly due to the high mortality associated with rupture of the aorta.² If the patient survives for several weeks a fibrous walled false aneurysm will form. The amount of time required to convert a pulsating haematoma into a false aneurysm is unknown, although Groves observed such a transformation as early as 23 days.³ When this

occurs in the ascending aorta, blood can be found in the pericardial sac because the parietal pericardium is attached to the ascending aorta just proximal to the origin of the innominate artery. Thus blood can dissect up into the great vessels and cause stenosis of the aortic or pulmonary artery. Blood may also dissect retrogradely and extend into the free wall of the atria, ventricles, or interatrial septum. Thiene *et al* reported 23 of 42 necropsy cases in which aortic rupture showed dissection of blood into the right atrial wall and in eight of these 42 cases had dissected into the interatrial septum.⁴ In our patient, the pseudoaneurysm dissected over the anterior aspect of the heart to compress and deform both the right atrium and right ventricle, severely impairing the function of the tricuspid valve. In addition, stenosis of the ascending aorta just proximal to the right innominate artery represents dissection antegradely impinging on the internal diameter of the aorta. In retrospect, the latter should have been a clue to the angiographic diagnosis.

To our knowledge, there has been only one report describing the pulsed Doppler echocardiographic diagnosis of a pseudoaneurysm.¹ Previously, cross sectional echocardiography has been well established as being capable of detecting pseudoaneurysms; but it has not been able to differentiate the entity from a localised haematoma, pericardial cyst, diverticulum, pericardial effusion, or true aneurysm.⁵⁻⁷ Angiography of the neck of the pseudoaneurysm has been the accepted procedure to confirm the diagnosis. The use of the pulsed Doppler technique has allowed the echocardiographer to determine blood flow characteristics timed with the cardiac cycle throughout the aneurysm, its neck, and the left ventricle. In our case cross sectional echocardiography showed the compression of the right heart. The Doppler technique was then used to trace the flow from the ascending aorta into the pseudoaneurysm. In essence, this

accomplished the same feat as angiography but with a greatly reduced risk and cost.

The most dramatic feature in this case is that pulsed Doppler echocardiography was able to demonstrate the neck of the false aneurysm and correctly traced blood flow pattern compatible with aortic flow through the neck into the aneurysm itself. This contrasts with the angiographic diagnosis of a "low flow fistula" between the sinus of Valsalva and the right atrium." Pulsed Doppler echocardiography also correctly predicted the lack of communication between the aneurysm and the right atrium or right ventricle. Thus this relatively new technique was instrumental in making the correct diagnosis.

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